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Smart cities and entrepreneurship: An agenda for future research

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ABSTRACT

Smart city is an entrepreneurial city. There is a bidirectional relationship between entrepreneurship and smart cities. First, entrepreneurs initiate technological interventions that help cities undergo socio-technical transitions and become smart cities. Second, the technologies being adopted in cities generate data which then helps enterprises to explore new opportunities. Despite the potential of this bidirectional relationship, this connection has been less explored. In order to fill the gap, this paper reviews the extant literature in the field to contextualize the role that entrepreneurship plays in building smart cities and how smart cities influence entrepreneurial business models. I referred to 479 papers published until June 2017 on smart cities and 35 papers out of those related to entrepreneurship using the method of clustered content analysis. This article contributes towards increasing our understanding of this bidirectional relationship, and opens up research avenues for future research in the fields of smart cities and entrepreneurship.

1. Introduction

Population growth in mega cities raises a number of concerns about the latter's capability to address basic problems of the growing urban population (Buijs et al., 2010; Munoz and Cohen, 2016; Zhang et al., 2016). Population growth requires increased resources to ensure minimum standards of life (Shahrokni et al., 2015). For example, Krausmann et al. (2008) argue that the rise in urban population would demand a 360 percent increase in the energy supply and 310 percent raise in material use. Such an increased need would seek utilization of existing stock of resources reasonably and sustainably.

Having seen the market potential when such a need opened up, technology-based firms came forward offering a number of solutions based on information and communication technology (ICT) to help use the existing resources effectively (Kummitha, 2018). The nature of the technology adoption is considered to help cities undergo socio-technical transitions and become smart cities. The European Commission (EC) defines smart cities as places "where traditional networks and services are made more efficient with the use of digital and telecommunication technologies for the benefit of its inhabitants and business.[1]" As an illustration, by adopting ICTs as part of their service provision, cities have been able to upgrade their water disposal facilities, adopt efficient ways of lighting and heating the buildings, and enhance urban transport networks. Given the significance of the technological visioning, several nation states have enacted new policies with an ambitious plan to transform their cities into smart cities. For instance, the Government of India adopted its smart city mission in 2015 to transform 100 cities into smart cities. Whereas Canada enacted Smart Cities Challenge, a pan-Canadian competition which encourages Canadian municipalities and regional governments to compete for grants which will be useful to adopt technological advancements as a part of their interest to become smart cities. Such an interest, as claimed by the EC, benefits various enterprises. Based on such a premise, Buuse and Kolk (2019) argue that smart cities provide opportunities for multinational enterprises to innovate and develop new technologies.

Accordingly, the dominant literature on smart cities argues that most of the technologies necessary for transforming cities into smart cities are developed and promoted by technological firms as part of their corporate entrepreneurship strategy (Buuse and Kolk, 2019; Paroutis et al., 2014). Corporate entrepreneurship refers to creation of new enterprises by an established corporation (Sharma and Chrisman, 1999) and is often employed to create new ventures in order to advance strategic renewal of established businesses (Hoskinsson et al., 2011) and help increase the competitive advantage of the focal firm (Zahra et al., 2006). Apart from enterprises playing a key role in developing technologies necessary for smart cities, once the technologies are adopted in cities, they generate enormous amount of open data, which is expected to open up new avenues, which further can be exploited by enterprises.

Although there is a general agreement that the adoption of ICTs would help cities become smart cities, there is no blueprint to follow or a smart city that has fully emerged yet as one. In this article, I

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[1] https://ec.europa.eu/info/eu-regional-and-urban-development/topics/cities-and-urban-development/city-initiatives/smart-cities_en, last accessed October 2019

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occasionally use examples from different cities which have been undergoing the transition to become smart cities. Despite the active role played by corporate entrepreneurship in the process of smart city building and the heightened criticism against its practice, there is a greater potential that smart cities offer in promoting entrepreneurial interest. Recent growth in the rationalistic stream of thinking in smart cities literature (Kummitha and Crutzen, 2017) underscores that the building of inclusive smart cities may be achieved by adopting a quadruple-helix model, where four key players need to be brought together (Kummitha and Crutzen, 2019): (a) the government to make an effective planning about how to allocate resources and create effective market policies, (b) corporate firms by offering technological expertise and knowledge, often in the form of corporate entrepreneurship, (c) small and medium enterprises (SMEs) and social enterprises that create small-scale developmental interventions, and (d) citizens playing responsible roles not only by being smart citizens but also by engaging in entrepreneurship to address local problems on a sustainable basis. When citizens play an active role in smart cities, they will encourage use of smart technologies, which then opens up avenues for technology-based enterprises to promote their production and benefit from the heightened technological usage. The quadruple-helix model thus encourages active participation of different types of enterprises to actively collaborate with the city administrators. EC, for instance, as part of its European Innovation Partnership on Smart Cities and Communities encourages cities, industries, SMEs, and communities to come together to form an alliance consequential enough for building inclusive smart cities.

When technologies are actively built into the urban infrastructure, they collect enormous data that is then useful for enterprises to exploit in order to enhance their own production line. Thus, first enterprises create a smart city market by offering technological infrastructure, which then creates avenues for enterprises to benefit. Despite the strength of this bidirectional relationship between entrepreneurship and smart cities, extant literature concerning smart cities, largely driven by sociologists, geographers, and urban planners, focuses on the neoliberal orientation of smart cities, and the way in which corporates lobby with the government to sell to cities the technologies they produce (Hollands, 2008; Datta, 2015). For example, the literature is critically vocal about the role IBM played in promoting the “smart planet” idea, which eventually resulted in creating smart city industry (Oberg and Graham, 2016; Hollands, 2015; Li et al., 2016). Further research expanded the critique to include other corporate firms such as Cisco, Accenture, HP, and Siemens about their active role in building smart cities (Buuse and Kolk, 2019). Accordingly, the recent literature published in *Technological Forecasting & Social Change* continue to discuss about a variety of concerns and tensions in connection to the building of entrepreneur-driven smart city (Kummitha, 2018; Martin et al., 2018). A major concern in the literature revolved revolves around how corporate firms create and promote ICTs and the way they lobby with the governments to use cities as test beds for the technologies they develop (Wu et al., 2018). Such a critical approach limits our understanding of the bidirectional relationship between smart cities and entrepreneurship.

In this article, I aimed to address this research gap by reviewing the research already conducted in the field. While doing it, I have also opened up research avenues which will help new research to grow in the fields of smart cities and entrepreneurship. Filling this research gap is important for both academia and industry because of three specific reasons. First, as emphasized by Letaifa (2015) earlier, despite the growing interest in smart cities across the globe and its implications for entrepreneurship, entrepreneurship scholars continue to ignore the growth and essence of smart cities. Second, filling this gap will help various enterprises to access additional knowledge about the potential opportunities smart cities offer (Quin, 2018). This is especially relevant, as Luque Ayala and Marvin (2015) highlighted, enterprises fall short of understanding how smart cities might help them advance their market potential.

Third, when it comes to entrepreneurship literature, continued research opportunity identification, and exploitation in emergent fields and opening up avenues to draw connection between smart cities and entrepreneurship is equally important to ensure the role entrepreneurship plays in contemporary society (Hoskisson et al., 2011; Pusavec et al., 2010; Tukker et al., 2008). Overall, there remains a gap in the research that entrepreneurship scholars would need to embark upon to account for the growing trends in the field of smart cities and help the entrepreneurial context of smart cities to gain visibility. In order to fill the gap, I review extant research published in the field and have tried to start a discussion on the bidirectional relationship between smart cities and entrepreneurship. The remainder of the paper is divided into three sections. The second section discusses the entrepreneurial context of smart cities, the third section highlights the methods adopted to select and review the literature in the field, and the final section analyzes the literature to offer an array of research avenues to promote entrepreneurship research in the field.

2. Smart city as an entrepreneurial opportunity

Cities are generally known for their creativity and innovation (Macke et al., 2018). They offer avenues for thriving entrepreneurial interest. Product or service consumption levels are generally higher in cities than in rural areas, which help business firms in exploring and exploiting new entrepreneurial opportunities. For example, the International Panel on Climate Change of the United Nations assesses that cities account for about 67 to 76 percent of total global energy consumption (United Nations, 2017). As the population of cities increases, the consumption and production patterns also significantly change and grow. Especially with the intention of cities to become smart cities, more robust and sustainable transition of cities is expected to be underway, leaving cities to adopt technology and big data-related resources to enhance city-level efficiency.

As defined earlier, smart cities adopt a networked infrastructure, also known as ICTs, that comprises of different technologies such as sensors to streamline traffic, household technologies that enable energy efficiency, advanced security, and hardware and software produced by the entrepreneurs.[2] Networked infrastructure does not only help cities in their social, cultural, and urban development, but also opens up new market opportunities for the entrepreneurs to exploit. This is because the sensors collect enormous data which is then available for entrepreneurs to use to advance their market propensity. The collected data further enables dynamic analysis of city life and provides material for entrepreneurs to make use of it in new and innovative ways. Given the significant potential for entrepreneurial participation, Kitchin (2014) highlights that smart cities promote “neoliberal ethos that prioritizes market-led technological solutions” (p. 2).

In order to produce new technologies necessary for cities, entrepreneurs propose new ideas and benefit from exploiting those ideas (Munoz and Cohen, 2016; Cohen and Winn, 2007). Schumpeter (1934) highlights that entrepreneurs are capable of creating new fields, pioneering radical diversification, and have the potential to transform the existing organizations by engaging in corporate entrepreneurship, individual entrepreneurship, or social entrepreneurship. A classic example for corporate entrepreneurship is IBM's smart city venturing. IBM started exploring and exploiting smart city entrepreneurial opportunity just after the financial recession of 2008 (Paroutis et al., 2014). The firm encouraged its employees to come up with new ideas and smart city was one such idea that helped it create a huge market potential in urban development space. The potential is such that both developed and developing countries adopt smart city vision and invite global firms to engage in corporate entrepreneurship. Given the potential, major

[2] Enterprises of different types include startups, corporate enterprises, SMEs, and social enterprises.

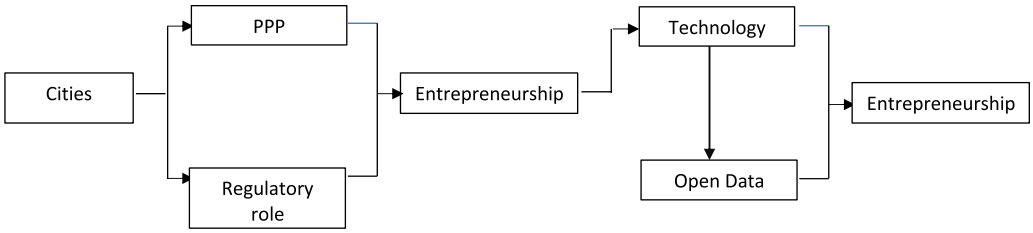

Fig. 1. Smart cities and entrepreneurial opportunities.

hardware firms such as IBM, Cisco, and Accenture among others have started to move to the sphere of urban service and consulting ventures (Hoskisson et al., 2011). Further literature highlights that citizens as individual entrepreneur come forward to play an important role in the development of smart cities by creating new technologies (Kummitha and Crutzen, 2019). Often citizens initiate SMEs and social enterprises to address local problems by inventing new technologies. For example, Kummitha and Crutzen (2019) argue that citizens act as entrepreneurs to create IoT-based interventions in smart cities.

Cities typically adopt two types of approaches in encouraging entrepreneurs to participate in smart city interventions: (a) promote public–private partnership (PPP) and (b) play regulatory roles.

As a part of the PPP model, city governments partner with corporates, SMEs, and citizens directly. In this connection, Munoz and Cohen (2016) mention that cities need to create a positive environment for the three key players–private players, people, and the policymakers to collaborate. While corporate firms engage actively in the creation of technological innovations as part of their corporate entrepreneurship strategy, Almirall et al. (2016) argue that governments also need to ensure that people at grassroots level are enthused about the creation of smart city-driven technologies conceptualized on the basis of the need at the grassroots level.

The technologies adopted to enhance the efficiency of cities generate enormous amount of data, which when collected can be used to create a number of entrepreneurial opportunities. The data is gathered by monitoring and assessing people movements and their activities, thereby aiming to make better city-level planning. The role open data can play in improving open governance, accountability, transparency, and citizen engagement is long proven. As Berrone et al. (2016) put it, "open data can enhance political and civic discussion" among citizens (p. 67). Further, open data can foster economic progress by enhancing entrepreneurial activity and encouraging new product and service development. By allowing citizens to access data, governments can thus stimulate innovative businesses and services that deliver social and economic value. For example, Barcelona city administration believes that open data is an asset for companies and entrepreneurs to create business models, which will help address unemployment and generate economic activities locally. How cities offer various entrepreneurial opportunities has been summarized in Fig. 1.

As part of the regulatory role, several cities reposition their city-wide ecosystems, allowing greater private sector participation. Policymakers create a supportive environment for entrepreneurs to benefit from. The change in the behavior of the government reflects upon the enriched role corporate entrepreneurship (Oberg and Graham, 2016) and citizen-led enterprises (Kummitha and Crutzen, 2019) play in smart city building.

Such a conducive environment offered by the State through its supportive policy allows corporate firms to innovate and offer advanced smart city solutions. The State in fact may offer tax benefits to encourage environmental-friendly technologies. For example, in the PlanIT Valley smart city, buildings are developed as "iBuildings" where household appliances are controlled with a touch button (Carvalho, 2015). This technology helps save household energy consumption and enhances security features of the new buildings. Given the potential for creating and promoting technological innovations and advancing city-wide living, corporate firms invest huge resources in smart city initiatives (Charted Institute of Buildings, 2011). For example, Cisco invested about $100 million each in smart cities in India and France, whereas it has committed to invest about $500 million as part of its "Deutschland Digital" project in order to transform Berlin into a smart city. IBM committed to invest about $3 billion in smart city projects. In fact, developed countries also chose smart city as a viable strategy and hence invest in promoting cities in the emerging economies. For example, Australia recently committed to invest $23 million to build smart cities in Southeast Asian countries.

While helping cities acquire necessary technological advancements, firms also benefit significantly when such technologies are implemented. First, they can capitalize upon the technology market; second, the IoT devices installed in cities help generate enormous data. Data has been so far used by firms to improve their inventory, enhance forecast, reduce lead time, and understand order frequency (Mortenson et al., 2015). Roden et al. (2017) in this connection emphasize that it is necessary to understand how big data helps enterprises create value.

Cities show interest to share the big data with citizens and start-ups, in order to allow them to create IoT interventions to provide public services in a more effective and sustainable way. For example, about 40 cities in the United States have developed websites for sharing open data, which citizens and start-ups may access and create smart city interventions (Cohen et al., 2016). Aarhus smart city in Denmark has made a significant effort to collect data sets and allow citizens and SMEs to access them. The data sets are also being used to develop mobile applications (Snow et al., 2016). In Helsinki, citizens developed about 100 mobile apps by using 1200 data sets publicly shared by the city council.[3]

In addition, several smart cities across the globe have started to promote SMEs and social enterprises (Mclaren and Agyeman, 2015). For example, a number of start-ups have embraced the idea of sharing economy and built business models around bike sharing, ridesharing, car sharing, and so on. Cohen et al. (2016) claimed that in order to create a supportive environment for those who are interested in bringing about technological advancements, cities offer lucrative infrastructure and environment. Accordingly, municipalities have started to institute dedicated divisions or offices for negotiating with various stakeholders to create infrastructure, including formulating necessary policies, in order to encourage entrepreneurship. Amsterdam smart city in the Netherlands and T-Hub in Hyderabad, India, are a few places where citizens are encouraged to create IoT interventions for the advancement of cities (Kummitha and Crutzen, 2019). Caragliu and Bo (2019) emphasize that creation of conducive environment at the city level encourages citizens to initiate social enterprises that not only address social problems but also create employment opportunities locally.

3. Methodology

I have adopted clustered content analysis method to analyze the literature. Hsieh and Shannon (2005) define content analysis as "a

[3] https://www.fastcompany.com/3024721/the-10-smartest-cities-in-europe#7

research method for the subjective interpretation of the content of text data through the systematic classification process of coding and identifying themes and patterns" (p. 1278). Content analysis is a valid research approach because it offers new insights and allows to enhance the visibility of existing research. It is a suitable strategy here because the aim of the present research is to explore a stream of research which is not yet systematically studied. Thus, content analysis helps in drawing insights from the sparse existing literature and thereby help advance our understanding of the phenomenon. Further, content analysis allows to open up research avenues which are derived from the existing literature.

3.1. Data and sampling strategy

In order to understand the bidirectional relationship between smart cities and entrepreneurship, my first step was to find out the existing research in the field of smart cities. Literature analysis involved three stages: (a) collection, (b) classification, and (c) clustered content analysis of the literature.

3.2. Collection

For the first stage, I conducted a multistage clustering of the research papers published on smart cities. I searched through EBESCO and Scopus databases by using single search phrase "smart cit*" to identify relevant articles published on smart cities for the review. As the search phase includes a wild card (*), I was able to find articles both containing the phrase "smart city" and "smart cities." I looked up articles published until June 2017. I referenced all scientific articles published in the field by using the said keyword and omitted editor notes, chapters, and popular essays. Thus, my focus was restricted to peer-reviewed articles only. With this search criterion, I found 479 articles from both databases. While EBESCO provided 387 articles, 408 articles were found through Scopus. However, when I merged both data sets, it was found that there was a duplication so I eliminated duplicated entries to finalize 479 articles for the current research.

3.3. Classification

In the second stage, I classified articles that focused on entrepreneurship. This process further narrowed the data set to 73 articles containing one or more of these words: *entrepreneur, enterprise, firm, corporate, business*, or *venture*. Table 1 shows the representation of each word by the number of the article containing them. By the end of the second stage, I was left with two sets of articles: articles that focus on smart cities (n = 406) and articles on the entrepreneurial context of smart cities (n = 73).

However, when I read through the 73 articles that deal with the entrepreneurial context of smart cities, I found that 38 articles would have to be omitted because they focused on the neoliberal context of smart cities, which typically criticized the smart city projects. Kummitha and Crutzen (2017) uphold that recent smart city literature is largely driven by the critical school where scholars end up criticizing smart city development and the role entrepreneurs play in building smart cities. Thus, I eliminated this set of articles from the analysis as they fail to offer any insights about how entrepreneurship contributes for smart cities or benefits from it. After the classification, I moved on to the final stage of analysis, that is, clustered content analysis.

Table 1
Articles on smart cites from selected databases.

Keyword(s)	EBSCO	Scopus	Total
Smart city + entrepreneur*	11	12	13
Smart city + enterprise	7	5	8
Smart city + corporate	33	45	41
Smart city + firm	5	12	14
Smart city + business	28	31	34
Smart city + venture	4	6	9

Note: Some of the articles are represented by more than one keywords.

3.4. Clustered content analysis

In the third stage, I then systematically reviewed the 35 papers that constructively represented the entrepreneurial context of smart cities to understand their contribution. During the review, I was able to classify each article under a major entrepreneurship subhead. For example, Paroutis et al. (2014) refer to IBM's strategy to identify opportunity in the context of smart cities, "the business considers recession as an opportunity to strengthen its competitive advantage and position itself for future economic recovery" (p. 264). I categorized this article under "opportunity identification and exploitation stream." Carvalho (2015) highlights that "the lack of active and socially mixed communities and the dominance of elite IT companies as knowledge producers have been hampering more widespread learning possibilities" (p. 51). I classified this paper under "Knowledge management." However, the authors conclude the article "by proposing a number of research avenues to strengthen the dialogue between the literature on smart cities, sustainability transitions and strategic niche management" (p. 45). Thus, I classify this paper also under "corporate entrepreneurship." Because, as discussed in the previous section, firms engage in smart cities as they open up new markets, which allows creation of new ventures and extending their strategic market reach.

Thus, the multi-stream classification allowed me to use several articles in more than one stream. The multi-stream classification allowed me to use several articles in more than one stream. In my review of the 35 papers, I came across insights about five specific streams of entrepreneurship research: (a) opportunity identification and exploitation; (b) corporate entrepreneurship; (c) knowledge management for venturing; (d) the role played by inter-organizations play in promoting smart city-driven entrepreneurship; and (e) the role of university and human capital.

Section 4 shows how I engaged in-depth cognizance of each of the research streams I identified. Table 2 highlights the major arguments under each research stream.

4. Analysis

I carried out a detailed analysis under each of the research streams given below.

4.1. Opportunity identification and exploitation

Shane and Venkatraman (2000) in one of their finest contributions to the entrepreneurship literature argued that entrepreneurship is a process "of discovery, evaluation and exploitation of opportunities" (p. 218). While opportunity identification leads to the origination of a venture idea, exploitation offers avenues for venture creation and growth. On a similar note, smart cities offer several such avenues for ventures to identify and exploit new market opportunities. Extant literature in entrepreneurship is focused on new venture creation by both individual entrepreneurs and corporate firms (Hoskisson et al., 2011). The idea of a smart city itself as claimed by the literature is an entrepreneurial idea promoted by global firms (Datta, 2015). Thus, the first research avenue that I identify is tied to opportunity identification and exploitation.

Entrepreneurship literature emphasizes that both software and hardware firms led by IBM initially identified and exploited opportunities in professional service and consulting businesses (Hoskisson et al., 2011). Similarly, by creating a new market in the form of smart cities, IBM engaged in its own revitalization (Paulin, 2016). Paroutis et al. (2014) highlight that IBM adopted the

Table 2
Articles reviewed and their key contribution.

Research stream	Key arguments	Number of papers	The papers
Opportunity identification and exploitation	• Smart cities offer several avenues for opportunity identification and exploitation. • IBM has played a central role in promoting smart city industry. • Enormous data generated by IoT devices open further entrepreneurial opportunities. • Smart cities also offer opportunities for citizens in cities to create niche technologies. • Quadruple-helix model offers a novel platform to promote an inclusive smart city planning.	9	Paroutis et al. (2014), Paulin (2016), Li et al. (2016), Kitchin (2015), Berrone et al. (2016), Puiu et al. (2016), Giatsoglou et al. (2016), Roden et al. (2017), Anttiroiko et al. (2014)
Knowledge management	• Smart city planning is mostly carried out by using top-down approaches. • When technologies fail to be appropriated locally, then they may result in a new set of social problems. • Educating citizens is equally important to create technologies. • Continuous interaction between firms and citizens is a precondition. • Learning from scratch is an intensive process to sense the local need. • Technology and data generation and its control raise more questions than providing answers. • Sociotechnical transition of smart cities offers a platform for innovation management. • Municipal innovation movement promote local innovations. • Data availability in the transportation system advances its efficiency. • By sharing the data, citizens are encouraged to address their own problems.	14	Carvalho (2015), Shin (2009), Shahrokni et al. (2015), Bakici et al. (2013), Fletcher et al. (2016), Glasmeier and Christopherson (2015), Paulin (2016), Visnjic et al. (2016), Del Giudice et al. (2016), Hollands (2015), Kummitha and Crutzen (2017), Goodspeed (2015), Hielkema and Hongisto (2013), Kitchin (2015)
Inter-organizational partnerships	• New technology markets increase technology consumption. • Citizens are worried about technologies hijacking their social life. • Place-based and customer-based technology development is necessary. • Changes in policy priority enable and disable smart city opportunities. • Cocreating offers mitigating strategies for firms. • Firms may prioritize expanding to new markets than creating impact.	9	Paulin (2016), Fletcher et al. (2016), Berrone et al. (2016), Burnes and Towers (2016), Anttiroiko et al. (2014), Carvalho (2015), Cohen et al. (2016), Tranos and Gertner (2012), Kummitha and Crutzen (2017)
Corporate entrepreneurship	• Big data and IoT influence supplier networks. • Three levels of supply chain integration, namely internal integration, customer integration and supplier integration, will be influenced. • Data is also a source to enhance firm-level customer intimacy. • As the number of players grows in supply chain, the complexity also equally increases. • Firms need to realign their supplier networks and operations model as new data unveils new opportunities. • Information sharing among partners is a complex task. • Firms typically adopt extended enterprise model. • Local supply chains are becoming less vertical, often comprising small and medium enterprises.	12	Oberg and Graham (2016), Allwinkle and Cruickshank (2011), Paroutis et al. (2014), Anttiroiko et al. (2014), Roden et al. (2017), Yu et al. (2013), Schiavone and Sprenger (2017), Visnjic et al. (2016), Tachizawa et al. (2015), Waller and Fawcett (2013), Hazen et al. (2014), Li et al. (2016)
University and human capital	• Need to enhance citizen skills by creating exponential human capital. • Quadruple-helix-based models enhance city-level capabilities. • Overwhelming data in the absence of able human resource create frustration for firms.	6	Kummitha and Crutzen (2017), Hielkema and Hongisto (2013), Almirall et al., (2016), Thite (2011), Tranos and Gertner (2012), McAfee and Brynjolfsson (2012)

concept of smart cities as a strategic option to deal with recession in the early 21st century. IBM's strategy included creation of a new venture called “smart city challenge,” which allowed it to engage with cities and offer technological and consulting services as a means to address the growing urban needs.

However, further research has shown that other technology service providers such as Cisco, Accenture, and Siemens among other firms have all potentially benefited from the smart city endeavor (Li et al., 2016). Although IBM retains the competitive advantage in the field being the “first,” other firms which followed the lead have also created their own strategies to effectively play a key role in the market. However, it is surprising to find that none of these corporate firms shares a common platform to define smart cities, except for the fact that they are ubiquitous in dictating that smart cities adopt technologies and data-based solutions (Kitchin, 2015). However, despite their active articulation, these firms fail to account for the competitive advantage IBM acquired in securing the contracts for offering their technologies (Li et al., 2016).

As discussed earlier, smart cities offer two different types of entrepreneurial opportunities to explore and exploit. First, the technology market opens up avenues for smart city service providers to innovate and introduce new technologies. Second, once the technologies are adopted, they collect enormous data, which come handy in identifying new opportunities. For example, a recent paper focused on building CityPulse, a platform that analyzes social media data and shares it with third-party vendors in order to improve efficiency in the cities (Puiu et al., 2016). Unlike citizen-reporting applications, where citizens need to register in specific applications to make complaints about the problems in cities, CityPulse gathers data from social media and the interactions that take place among citizens and from their status updates. This platform emphasizes about leveraging social media for crowd sourcing data from communities (Giatsoglou et al., 2016). Thus, by using open data, city-level problems can potentially be addressed before they become prominent. Let's take Google for instance. Based on the search trends in its search engine, prevalence of flu was identified much before patients visited the hospitals, which helped planning and

accumulation of necessary drugs and adequate staff (Roden et al., 2017). Having a tech platform to collect, model, and aggregate social data offers avenues for creation of third- party applications as entrepreneurs are generally interested in using such data to create apps. This is equally visible in both developed and developing countries (Giatsoglou et al., 2016).

In addition to the corporate entrepreneurship, several cities are coming forward to offer a conducive environment for their citizens to address their own problems by creating technological innovations. Individual citizens show heightened interest in identifying or creating such opportunities in cities (Gartner, 1985). Thus, studying how individual citizens and the environment in which they are present interact with each other in order to ensure that citizen-driven entrepreneurial opportunities are exploited and the value created at city level is important (Gatewood et al., 1995). This makes Bhave (1994) highlight that the environment in which entrepreneurs initiate ventures plays a crucial role in the success of the ventures. In Hyderabad, India, the city police have launched Hyderabad Traffic Live app, from which citizens can directly contact the traffic police to share information, concerns, and suggestions or lodge complaints (Kummitha and Crutzen, 2019). This app was developed by a local start-up. Thus, it is not only the corporate firms which benefit from smart city opportunities but also the start-ups which grab the opportunities they identify as a part of the smart city. Given the important role smart cities play in promoting entrepreneurship, I propose the following research questions that are worth considering for future research.

4.1.1. Research questions

1 How do corporate firms differ or agree with each other while building smart cities?
2 How IBM's competitive advantage is challenged by the other technology service providers?
3 How firms create or discover and exploit data-based opportunities and how are they different compared with technology-based opportunities?
4 How are the niche opportunities identified or created and how SMEs assemble resources to initiate the ventures?
5 How smart partnerships among various stakeholders enable necessary synergies to foster innovations enacted by smart citizens?
6 How are the multiple ecosystems in place to foster both corporate-driven technological innovations and citizen-driven technological innovations simultaneously?
7 How do different country-specific and region-specific institutional contexts offer necessary environment for both corporate entrepreneurship and citizen-driven enterprises to thrive?

4.2. Corporate entrepreneurship

The two key pillars of smart cities—technology and big data—influence the way technology firms operate in markets (Oberg and Graham, 2016). The literature argues that most of the research in smart cities has so far focused on urban planning aspects, leaving out how the urban markets allow corporate entrepreneurship to thrive (Allwinkle and Crucickshank, 2011; Paroutis et al., 2014). The enhanced use of technology and possible change in the consumer behavior offer scope for various types of enterprises to benefit (Li et al., 2016).

Although smart city technologies are mostly driven by corporate entrepreneurship initiatives, they also engage other SMEs in their supply chains. As the number of players taking an active role in the operations and supply chain grows, the environment becomes complex. As part of the smart city endeavor, legislators and city councils, who take decisions about the needs of the city and set sustainability parameters, play a pivotal role by offering right directives and seeking necessary products for sustainable living (Roden et al., 2017). Thus, enterprises not only need to realign their business models but also coordinate with the city government, citizens, and other members in supply chain among others.

On the other hand, the beneficial impact information technology has on firm performance has long been demonstrated (Yu 2015). The technological advancements are said to play a pivotal role at three levels of their supply chain integration, namely internal integration, customer integration, and supplier integration (Yu et al., 2013). In this connection, big data offers significant advantages for the market performance of corporate firms (Gölzer and Fritzsche, 2017). By using big data, firms can collaborate or form alliance with other firms and SMEs and optimize customer value across the industry. Big data may be useful for several aspects of firm performance, especially to draw distribution strategies based on consumer pattern and locations generated by their mobile phones. For example, firms may learn where and how consumers drive their cars based on which they define inventory and distribution locations (Manyika et al., 2011). Schiavone and Sprenger (2017) further articulate that big data offers opportunities for firms to digitalize in-house processes, value chains, and operation models. For example, by using big data, firms could transform their operation models into more efficient ones (Roden et al., 2017). As smart city opportunities are often exploited as part of the corporate entrepreneurship strategy, firms need to understand the key markets and the social aspects that push the boundaries of smart cities and make an effective planning to satisfy all sorts of reasonable demands coming from various players.

In several smart cities, firms adopt “extended enterprise” model where a lead enterprise encourages specialized start-ups to develop components that may be integrated by the extended enterprise to offer the final technological product. The lead firm generally wields the controlling power and regulates the flow of resources in the supply chain (Gulati et al., 2000). For example, in Vienna, most of the smart city projects are delivered by “extended enterprises,” where the “integrator” plays a key role in delivering the projects. The integrator could be a government entity or a private firm. In Vienna, the public transportation department offers pivotal importance to citizen needs, thereby promising to offer integrated, competitive, and efficient public transportation. Accordingly, various players in the supply chain of transport department are asked to maintain quality standards and focus on the needs of the people (Visnjic et al., 2016).

Technology firms are historically known for their potential in offering services and products to other organizations. For example, IBM is known for producing consulting and hardware infrastructure. However, the moment when IBM enters into city planning, where they have to deal with projects that have direct implications on communities, they need to gain a clear understanding of those communities. Because when needs are homogeneous, and a proposed solution is particularly complex, then it will be difficult for the lead agency to achieve the efficiency of the product (Visnjic et al., 2016). In smart cities, as a number of corporate players are involved wherein they offer a variety of products, there is a need for all of them to understand the local context and gain legitimacy locally. This is especially important when a variety of organizations, which offer different components, would need to collaborate and integrate their expertise to create a product.

Further, the potential benefits from data mining under smart cities might result in complexities for the entire extended enterprises. For example, based on the data collected and analyzed about customer choices, when a lead enterprise decides to situate urban consolidation centers in certain locations to minimize its last-mile distribution costs against favorability of the extended enterprises, the extended enterprises might find it hard to realign their resources (Tachizawa et al., 2015). A recent study conducted by European Parliament claims that local supply chains in smart cities are becoming less vertical and often comprise SMEs and startups (European Parliament, 2014). Apart from being influenced by the policy to follow certain standards in smart cities, firms may also be proactive and set market standards and influence the policy (Oberg and Graham, 2016). In fact, new firms may be formed

based on the need as and when arising in the process.

It is argued that the open data is instrumental in creating a new source of customer intimacy (Waller and Fawcett, 2013). Li et al. (2016) argue that smart cities result in a fundamental shift in the way how citizens engage with firms where products and services are designed and delivered in a customer-centered method. For example, market digitization helps reduce costs and enhance organizational ability by producing new link between buyers and suppliers. Cities like Chicago formed dedicated sourcing agencies such as Chicago Infrastructure Trust, which partners with the stakeholders and companies from private sector and pulls resources and infrastructure to address the needs of the city. Firms could benefit from this development, as both the quality and quantity of the data is useful for firms to enrich customer experience (Hazen et al., 2014). I offer the following research avenues for further research in this stream.

4.2.1. Research questions

1 How do smart cities help advancing efficiency in the operation models?
2 What strategies city governments adopt to help establish small firms that could supply necessary products and services?
3 How does an extended enterprise model work in smart cities, especially when a government agency acts as a lead enterprise?
4 How do smart city technologies gain legitimacy from communities and policymakers?
5 How can extended enterprises adjust their own operation models in consistence with the lead enterprise?
6 How can SMEs, as part of a larger supplier network, benefit from the smart city interventions?
7 How can existing firms cope up with the changing landscape and new ways of doing business in smart cities?
8 How can firms set standards in smart cities and engage in institutional entrepreneurship?
9 How do existing firms without technological expertise benefit from this growing trend of technological adoption and acquire necessary expertise?

4.3. Knowledge management

As discussed, most of the smart city technologies are top-down in nature where corporate firms as part of their corporate entrepreneurship strategy play an active role in developing and implementing technologies in cities (Carvalho, 2015). Brock et al. (2019) in their recent contribution highlight that the product-centered business model adopted in smart city markets fails to offer an inclusive developmental path. For example, Cisco signed a contract with Songdo in South Korea, and PlanIT Valley in Portugal to offer TelePresence technology (Lindsay, 2010) whereas IBM partnered with Rio in Brazil. The technologies these corporations develop are present everywhere in cities as a part of the city–corporate lobbying (Lindsay, 2010; Shin, 2009). Such technologies are then pushed onto cities without assessing their local relevance (Kummitha, 2018). When technologies are pushed onto cities, and fail to be appropriated in the local context, they may create additional problems, denting the prospects of cities to attain efficacy at the city level. Accordingly, Shahrokni et al. (2015) argue that despite having sophisticated technologies and sensors to track and analyze data, it is equally important to educate and understand the concerns of the citizens in connection to the governance of smart cities. Thus, the knowledge flow from the bottom to the top level is an essential component of smart cities. It is in such a scenario, enhanced interactions among citizens and firms mediated by the public policy eventually create knowledgeable societies (Bakici et al., (2013), which will then result in citizens initiating interventions that address their own local problems (Fletcher et al., 2016).

Carvalho (2015) recommends learning from scratch as an intensive process in terms of sensing the need of the grassroots- and local level before developing or promoting technologies. The matchmaking between tech platforms and social platform by connecting them with each other is an ideal approach to enhance effectiveness in cities. Although there is little doubt about the role technology plays in advancing human experience (Orlikowski, 2007; Orlikowski and Scott, 2008), and about the role of technology in building smart cities, the bigger question often raised in the literature is how to develop an inclusive environment for smart city building. The data being generated from the technologies has also come under sharp critique. For instance, Paulin (2016) asks who will use and operate the data collected in smart cities.

Despite critical claims about technology development, top-down approaches, and data management, the literature argues that addressing complex social problems, especially those that are associated with smart cities, is a mammoth task which would require various enterprises to come together (Visnjic et al., 2016). Especially sharing knowledge between the enterprises is a key practice. Under the smart city label, enterprises are expected to be “smarter” and engage in effective collaborations to allow city-level network building, which is necessary to connect various devices installed by different technology service providers. Thus, firms need to make necessary planning to share knowledge and information with each other (Del Giudice et al., 2016).

Accordingly, Goodspeed (2015) proposes the need for municipal innovation movement, which enables the development of locally built information technology. Hielkema and Hongisto (2013) argue that living labs have the potential to promote ideation and offer avenues to create knowledge at the ground level. For instance, by accessing data related to the transportation system in Helsinki, developers are expected to create novel applications to enhance the efficiency of the transport systems. By making the data public, the government and living labs enable citizens and businesses to identify and exploit innovative opportunities. Social and cultural contexts also play a dominant role in determining individual intent to participate in smart city interventions.

Cities need to create avenues for social interactions between various key players. For example, socioeconomic literature in general and embeddedness literature in particular argue that any economic action is not a stand-alone as it is influenced, enhanced and mitigated by the social sphere (Granovetter, 1985). Thus, it is imperative for firms that are part of smart city projects to take knowledge from the social structures and contexts into consideration while planning and executing smart city strategies. In this regard, Kitchin (2015) emphasizes that the critique raised against smart cities, and their push on technology has resulted in technology providers such as IBM and Cisco to transform their typical top-down approaches into citizen-centric and inclusive-oriented approaches that ensure citizen participation in planning and adoption of technological innovations. Moreover, locally embedded planning and execution is necessary to achieve social inclusion (Tranos and Gertner, 2012; Kummitha, 2017). I believe that addressing the following research questions may enhance our understanding about data and knowledge management in smart cities.

4.3.1. Research questions

1 Under what circumstances do firms promote niche technologies?
2 How do cities promote bottom-up interventions where technologies are invented by citizens who are later expected to use or benefit from them?
3 How do policymakers mitigate tensions between firms and communities who participate in smart city projects with varying expectations and help create blended value?
4 Under what circumstances do firms shift their approach from top-down to bottom-up or to creating an intermediate context?
5 How do the corporate firms develop their technological capabilities? Are the technological ideas developed centrally then pushed locally, or are they locally developed?

6 What kind of strategies smart city administrators adopt in educating citizens about the usage of technologies?
7 How do smart cities allow knowledge transfer from grassroots level to create inclusive technologies?
8 How can firms benefit from the presence of ICTs and how do they allow knowledge sharing within and across the firms?
9 How are technologies and data used and operated in cities?

4.4. Inter-organizational partnerships

While smart cities play a dominant role in terms of pushing technologies on cities to enhance their efficiency, the literature argues that new technologies often increase consumption (Lawhon and Murphy, 2012). While increase in consumption is a promising scenario for an active market, there rises sustainability questions as smart cities might end up enhancing consumption levels among the citizens and cities, which may cause environmental problems. Although social life being regulated by technology sounds fascinating, where people benefit from technological innovations, there are far more negative consequences for social functioning. In fact, technology may distract social networks, restrict human interactions, and reduce social capital. In this connection, Fletcher et al. (2016) argue that the citizens are worried about technology hijacking their social life and creating unsustainable societies. Accordingly, they emphasized the need for technology-free zones. Thus, in order to address a variety of problems that emerge while implementing smart city technologies, inter-organizational partnerships are essential.

One of the key aspects discussed in the literature is about the collaborative role various organizations represented by individuals with various backgrounds need to play in building smart cities (Kummitha and Crutzen, 2019). Anttiroiko et al. (2014) emphasize that "smart cities need an eclectic mix of visionaries, engineers, business leaders, policymakers, proactive citizens, and communities. They can facilitate more smart behaviour in response to growing urban problems" (p. 331). Whereas Kummitha and Crutzen (2019) highlight that the government, private sector, citizens, and universities need to come together to build smart cities. Thus, bringing various stakeholders under one umbrella to draw a unique smart city model would be an interesting aspect. One of the first steps in this direction is initiated by Fletcher et al. (2016), who collected views from various stakeholders of High Street in London, thereby offering a novel contribution to understand the overall city-level aspirations.

As discussed, building smart cities is a policy priority for many cities and countries across the globe. Thus, policy change could actively hamper the potential of smart city building. For example, election of new political representatives would result in priority shifts where new opportunities are both enabled and disabled. Carvalho (2015) argues that both Songdo and PlanIT Valley smart city projects were active when they were first initiated; however, they started to lose momentum over a period due to reduced interest among policymakers. Further evidence is offered by recent research, that projected raising concerns about the victory of the Left coalition in 2016 city elections in Barcelona. Because the election results jeopardized the then existing lucrative open data policy as the new mayor indicated his priority to promote social policies pertaining to social inclusion agenda over technology and collaborations (Cohen et al., 2016). Such transformations have significant financial implications for the firms. Community pressure often results in policy changes because communities often feel alienated in the process of smart city building, as most of the projects are introduced by corporate enterprises using top-down approaches (Hollands, 2008; Datta, 2015). One way of mitigating these risks may be to offer a dais for a variety of players to form an alliance in building smart cities (Kummitha and Crutzen, 2019). Based on this discussion, I highlight following research questions which may come handy for advancing literature in research based on inter-organizational partnerships.

4.4.1. Research questions

1 While inventing and upgrading technologies, how technology providers or governments prevent over usage or restrict consumption levels in cities?
2 How smart cities enhance social capital and social networks in cities by enabling various organizational forms to come together to build inclusive smart cities?
3 What kind of strategies firms adopt to stimulate short-lived interests from political elite and city administration?
4 How do smart city planners balance the expectations to build inclusive smart cities?
5 What role various players in quadruple-helix model play in smart cities?
6 How various forms of organizations including SMEs and social enterprises address problems in cities and create blended value?

4.5. Universities and human capital

Literature argues that cities need to first enhance skills of their citizens to enrich their participation in smart city interventions (Kummitha and Crutzen, 2017). Universities have to play a key role in cites to create a strong cadre of citizens who could take up three specific roles. First, they can articulate their needs and build their own technologies. Second, they will actively partner with enterprises in order to articulate their needs. Third, they will join the enterprises as employees and contribute to the smart city interventions.

Further, the higher the human capital gains, the greater the city invents and gains economic growth (Porter 1990). One of the major aims of smart cities across the globe apart from offering best living conditions for their citizens is to become most sought after cities for living, so that they can attract best of the talent. There are several instances from emerging smart cities across the globe where cities enacted policies to create a stock of human capital which has the potential to initiate enterprises of different types. Helsinki Living Lab, for instance, encourages collaborations between academia and industry to foster citizen-led smart city interventions (Hielkema and Hongisto, 2013). Another example comes from the crisis-led Medellin city, where university–industry–State-led committee in collaboration with citizens started several citizen-driven interventions in the city. The interactive city developmental plan helped the city to become the world's most innovative city in 2012 from what was the world's most violent city in the late 1980s and early 1990s (Almirall et al., 2016). Thus, institutions need to create necessary infrastructure to enable creation of a conducive environment for citizens who can be encouraged to be creative and to attract creative people into the city. Especially, universities need to enter in partnerships with policymakers, industry, and citizens to offer the necessary platform to create inclusive smart cities where citizens play an active role. In a recent study, Kummitha and Crutzen (2019) highlight that in Hyderabad smart city, India, while elite universities make inroads for creating superior human capital necessary for building smart cities, a majority of universities fail to train individuals with a minimum standards of human capital; as a result, they argue that the scenario leads to "talent in and talent out." "Talent in" refers graduates of elite institutions creating enterprises, whereas "talent out" refers to the created entperirses relocating to other cities as they are unable to recruit talented human capital in their ventures.

Thite (2011) argues that knowledge and creative workers bring sustainable competitive advantage to cities, allowing enterprises of different types to work effectively. The availability of knowledgeable citizens in cities allow them to compete with other cities. Cities with large human capital at their disposal can attract talent. Nam and Pardo (2011) argue that smart citizens in smart cities encourage lifelong learning, flexibility, creativity, and open mind. The presence of like-minded people with higher human capital results in higher competition,

which makes smart cities smarter (Glaeser and Berry, 2006). However, it is argued that high skill migration across cities has not received sufficient attention in the literature (Tranos and Gertner, 2012).

When it comes to advantages for enterprises, although data and technology usage offers several avenues to improve product line and customer satisfaction, overwhelming data creates frustration too. Especially when firms fail to recruit talented human capital, the scenario leads to a situation of "talent out" where firms may either chose to move to other cities or close down their operations completely. For example, eBay generates about 50 TB of data every day. Although the data is about how people navigate the website (eBay) and could potentially help in arranging its supply chain, eBay finds it hard to identify ways in which it could take advantage from the data (Kiron et al., 2014; McAfee and Brynjolfsson, 2012). One potential problem for this concern is related to finding the right talent. Firms that find the right talent gain advantage from analyzing the data in the right way. For example, customer-tracking technology of Walmart enables it to go deeper to understand the buying preferences of its customers and help the organization to reposition its supplier networks accordingly. Thus, universities need to play a key role in producing talented citizens, who then create their own enterprises or join existing enterprises as intrapreneurs. Based on this understanding, I offer the following research questions for enriching this stream of research.

4.5.1. Research questions

1 How can universities play a key role in building smart cities?
2 How can government and businesses attract necessary human capital to build smart cities?
3 How do firms manage their human resources to navigate through the data and help their own strategy building?
4 How do universities help advance human capital of the citizens who are expected to create enterprises of different types or join existing enterprises?

5. Conclusion

Although extant literature in smart cities is vocal about entrepreneurial urbanism (Kummitha, 2018), there has been little research by entrepreneurship scholars to investigate the entrepreneurial context (Letaifa, 2015). One of the major reasons for the lack of interest is due to the heightened criticism in the literature, which is dominated by sociological, urban planning and geographical researchers, on the role entrepreneurs play to force fit technologies. Given its newness, entrepreneurship scholars and smart city based scholars have not shown keen interest to strengthen the research. Because of inactive scholarly community in the field, the anecdotal evidence in the literature reduces the role of enterprises in smart cities as agents of neoliberalism (Vanolo, 2014; Gibbs et al., 2013). This not only does constrain the growth of smart cities from being effective, but it also underestimates the role entrepreneurship plays in the process. Building on this, the present article examined the bidirectional relation between entrepreneurship and smart cities, and highlighted several avenues for future research.

The review helped in discussing various important issues under each category, which then opened up avenues to raise further questions, that I believe will come handy for future research in the field. I hope that future research will address the legitimacy questions corporate enterprises face and shed light on the inclusive role that firms could play in creating inclusive smart cities. Apart from addressing these questions, I also encourage scholars to take up case study research that highlights novel practices carried out in various cities. Especially when a field is in the emergent stage, case studies offer rich descriptive understanding and allow researchers to adopt explorative approaches to describe novel practices. While I argue that addressing the research questions I highlighted is useful for the field to grow, I especially encourage scholars to engage in research pertaining to inclusive smart city building and the quadruple-helix model. Also, how corporate firms, citizens, government, and universities come forward together to create an inclusive smart city that fulfills ambitions of various stakeholders who live in the city. I believe that the research questions I have identified serve as a trigger for the much needed push in augmenting our knowledge concerning the role entrepreneurship plays in smart cities. As the research areas I have presented in this review article are not exhaustive, I encourage other researchers to take an active role in guiding the research forward to match the growing contribution entrepreneurship makes at grassroots level in building smart cities.

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